Original Article

Intraindividual Association Between Shift Work and Risk of Drinking Problems: Data from the Finnish Public Sector Cohort

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Abstract

Objectives Studies concerning the association between shift work and drinking problems showed inconsistent results. We used data from a large occupational cohort to examine the association between shift work and different types of drinking behavior.

Methods A total of 93 121 nonabstinent workers from the Finnish Public Sector Study were enrolled in the study. Six waves of survey data were collected between 2000 and 2017. Work schedules were categorized as regular day, nonnight shift, and night shift work, and shift intensities were calculated from registered working hour data. Two indicators of adverse drinking behavior were measured: at-risk drinking (>7 and >14 drinks per week in women and men, respectively) and high-intensity drinking (measured as pass-out experience). Intraindividual analysis was conducted using fixed-effects regression to examine the association between shift work and drinking behaviors.

Results Compared with regular day work, night shift work was associated with an increased risk of high-intensity drinking (odds ratio [OR] = 1.28, 95% confidence interval [CI] = 1.07–1.52) but a lower risk of at-risk drinking (OR = 0.85, 95% CI = 0.74–0.99). Shift workers who worked long shifts had a lower risk of at-risk drinking compared with those who rarely worked long shifts (OR = 0.58, 95% CI = 0.37–0.93).

Conclusions Associations between shift work and alcohol use vary according to drinking patterns. Workers engaged in high-intensity drinking more often during night shift schedules compared to day work, but did not drink averagely higher volume.

Key terms: shift work; at-risk drinking; high-intensity drinking; cohort study; sleep

Key Messages

What is already known about this subject

- Studies concerning the association between shift work and drinking problems showed inconsistent results.
- Few studies have examined different drinking behaviors in a longitudinal cohort of employees.

What are the new findings

- Workers did not averagely drink more when they worked night shifts, but engaged in more high-intensity drinking.

How might this impact on policy or clinical practice in the foreseeable future

- Interventions aimed at increasing awareness of the potential consequences of high-intensity drinking among night workers should be advocated.

INTRODUCTION

Problem drinking among the working population is a serious workplace health concern associated with increased sickness absence and disability retirement.[1,2] Various work-related factors have been evaluated as possible risk factors for problem drinking in the working population, including long working hours,[3] low job control and high psychological demands,[4,5] and work-family conflict among female employees with preschool children.[6] Some studies have reported that a higher percentage of shift workers consume alcohol as a sleep aid than day workers.[7,8] Shift work disturbs the sleep–wake rhythm and increases the risk of sleep disturbance, whereas alcohol reduces sleep onset latency.[9] Therefore, shift workers may have an elevated risk of drinking problems. However, studies concerning the relationship between shift work and drinking problems are scarce, and the findings are inconclusive.

Some cross-sectional studies have shown negative associations between night work and alcohol misuse,[10] drinking volume,[11] and heavy drinking.[12] Although longitudinal studies have been scarce, a 1-year follow-up study found that workers who changed from day to night work consumed more alcohol by volume.[13] However, a 6-year longitudinal study did not find an association between night work history and at-risk drinking among women employees.[14] The inconsistency in findings across

studies may because of different definitions of night work and shift work based on imprecise or missing information on the shift systems in use. For example, night shift has been defined as working any time between midnight and 6AM,[14] or at least 3 hours between midnight and 5AM,[15] or self-reported "worked in the night".[13] The health effect of night shift work may not be comparable between studies. In addition, two types of adverse drinking behavior, i.e., at-risk drinking and binge drinking, have not been investigated systematically in shift work studies.

At-risk drinking (i.e., high average drinking volume per week) and binge drinking (i.e., high drinking volume per episode) are considered preferable measurements for drinking problems than average drinking volume alone, because these forms of drinking are detrimental to health and correlate with the negative consequences of shift work on occupational and social functioning.[16] For example, at-risk drinking causes cognitive deficits and sleep impairment, further disrupting work performance,[17] whereas binge drinking is associated with increased injury, sickness absence, and loss of productivity.[18,19]

A significant portion of binge drinkers drink much higher volume of alcohol, with levels two or three times the binge threshold.[20] This extreme form of drinking behavior, termed as high-intensity drinking, is associated with more frequent and serious alcohol-related problems compared with binge drinking, including injuries,

risky behaviors, passing out, blacking out, worse daily functioning, and sleep difficulties.[21] Drinking to cope with negative mood was observed to be a risk factor for high-intensity drinking,[22] whereas shift workers were observed to have higher levels of mental distress.[23] Shift work may be associated with high-intensity drinking; however, few studies have evaluated the association between shift work and this type of drinking behavior.

Given the inconsistent evidence for the relationship between shift work and drinking problems, this study investigated the relationship between shift work and different aspects of drinking behaviors (i.e., at-risk drinking and high-intensity drinking). Using a cohort data from 17-year follow-up of over 90 000 employees, we examined the association between shift work schedule and shift intensities and drinking behaviors, with adjustments for family burden of caring young children, working hours, and job demands. Because drinking behaviors and related consequences varied by sex,[24] we further examined the interaction effect between sex and shift work.

METHODS

Study design and participants

Our analyses were based on the prospective Finnish Public Sector (FPS) study, which

comprised the following two studies: 1) the ten-town study, a study of local government employees in ten towns, and 2) the Work and Health in Finnish Hospital Personnel Study, a study conducted in 21 hospitals. We used waves of survey data from each study: from the first study, surveys taken in 2000, 2004, 2008, 2012, 2014, and 2016 were used; from the second study, those taken in 2000, 2004, 2008, 2012, 2015, and 2017 were used. Data from 2014 and 2016 of the ten-town study were combined with data from 2015 and 2017 of the hospital study for six waves of survey data—2000, 2004, 2008, 2012, 2014–15, and 2016–17. The response rates of the six waves varied from 67% to 72%.

A total of 149 303 people participated in at least one wave. To examine changes in drinking behavior over time, only those who had participated in at least two waves of survey (N = 96 651) were included (Figure 1). Lifetime abstainers were excluded (N = 2219). Register-based data on working hours were available for 27 125 respondents; 12 073 had regular day work and 15 052 worked shifts. The registry data of working hours were obtained from the Titania® shift-scheduling software, which was used by the hospital workers of the FPS study cohort during 2007–2017. We included only workers who had at least 150 shifts and 300 contract days during the preceding 365 days. The Ethics Committee of the Hospital District of Helsinki and Uusimaa approved the FPS study (HUS 1210/2016).

Measurement of work schedules and shift intensities

Work schedules were classified as regular day, nonnight shift, and night shift work based on the survey data. In the ten-town study, participants in the 2000 and 2004 waves were asked: “Is your work regular day work?” with response options of “Yes” or “No.” If the answer was negative, they were asked whether their work included evening, night, or weekend shifts. Participants were classified as day workers if they answered “Yes” to the initial question, as nonnight shift workers if they answered “No” to the initial question and indicated that their work included evening but not night shifts, and as night shift workers if their work included both night and evening shifts. Participants who selected any other combination of responses were excluded. In the 2008 and later waves of the ten-town study and in all the Work and Health in Finnish Hospital Personnel Study waves, participants were classified according to whether they described their current work as day work, nonnight shift work, night shift work, fixed night work, or other irregular work. Participants who reported fixed night work or irregular work were excluded due to the small size of these groups. The questions on shift work and classification were validated against the objective register data for work hours.[25]

We further linked the register data to survey data from 2007–2017 for 27 125

participants. We included only workers with at least 150 work shifts and 300 contract days in the preceding 365 days. We further excluded 12 073 regular day workers, leaving 15 052 shift workers for analysis. Register data for daily working hours of 365 days prior to each survey were used to calculate annual mean characteristics of the working hours on the basis of length, timing, recovery, and social aspects, as described previously.[26] The shift intensity variables used in this study were average weekly working hours; percentage of evening shifts, night shifts, and long shifts (≥12 hours); percentage of quick returns (<11 hours) for all shift intervals; percentage of single free days for all free days; and percentage of >40-hour weeks [26]. The shift intensity variables were dichotomized by >10% for long shifts and >25% for other variables. The cutoff values were chosen according to the distribution of these shift intensity variables in the FPS cohort.[27,28]

Measurement of drinking behavior

We examined at-risk drinking and high-intensity drinking. The participants were asked whether they had consumed alcohol in their lifetime. The abstainers were excluded, and the remaining participants reported their average drinking volume of beer, wine, and spirits, respectively. Pure alcohol volume consumed per week was calculated, and >7 drinks (one drink = 12 g of alcohol) for women and >14 drinks for

men per week were defined as at-risk drinking.[29] The measure of high-intensity drinking has been operationalized as drinking enough to stumble or pass out by self-report.[20,30] For measuring high-intensity drinking, participants were asked how frequently they had passed out due to drinking in the previous year. The participants were classified as partaking in high-intensity drinking if they reported passing out at least once. Self-reported passing out has been used in previous studies as a measure of high-intensity drinking[31] and its association with hazardous drinking contexts was similar to objective measures such as blood alcohol concentration and drinking volume per episode.[20]

Other variables

Difficulty falling asleep was assessed by the frequency of experiencing difficulty falling asleep during the previous 4 weeks.[32] Participants chose from not at all, 1–3 days a month, 1 night per week, 2–4 nights per week, 5–6 nights per week, and every day. Difficulty falling asleep was defined as ≥2 nights per week; ≤3 days a month was the reference symptom frequency for the intraindividual comparisons over time.[33] Psychosocial job demands were evaluated using three questions (hard work, insufficient time, and a lot of work) derived from the original Job Content Questionnaire using the job strain model of Karasek and Theorell.[34] The measurement

of job demands with partial items was proven valid.[35] The responses were recorded using a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), and the mean scores were ranked and divided into tertiles (low, medium, and high).

Age, sex, and occupation were obtained from employer records. Information on having young children (<6 years old) and weekly working hours was collected through the questionnaire, but working hours were retrieved from the register data to include objective information.

Statistical analysis

The distribution of baseline age, sex, drinking behaviors, self-report working hours and job demands, and difficulty falling asleep was described. Differences between baseline characteristics by shift schedule were examined using chi-square tests.

Longitudinal fixed-effects logistic regression modeling was used to examine the associations between intraindividual changes in shift work status and changes in outcome (drinking behaviors) between surveys. The advantage of using a longitudinal fixed-effects model is that time-invariant known and unknown confounders are eliminated when intraindividual changes over time are examined.[36] The participants therefore served as their own controls. The odds ratio (OR) for at-risk and high-

intensity drinking was estimated. Only data on participants with changes in drinking behaviors between survey waves were considered informative and included in the fixed-effects models. In crude models, shift work status and survey year were included as independent variables. In adjusted models, we further included time-variant covariates, i.e., weekly working hours, having young children, and job demands. Sex was treated a time-invariant variable and its interaction with shift work status was examined in adjusted models. Dummy variables were created for missing values of having young children in the logistic models.[37]

To further examine the association between difficulty falling asleep and drinking behaviors among night shift workers, we identified participants who worked night shifts in any two waves of survey. The association between difficulty falling asleep and adverse drinking behaviors was examined with fixed-effects models adjusted for the covariates. The derived odds ratio represents the risk of difficulty falling asleep for adverse drinking behaviors when an employee worked night shifts. SAS 9.4 (SAS Institute, Cary, NC, USA) was used for all the analyses, and the significance level was set at $p < 0.05$.

RESULTS

At baseline, regular day workers had a higher percentage of at-risk drinking (13.7%)

than shift workers (adjusted $p < 0.001$; Table 1). Average (SD) weekly drinking volumes for day, nonnight shift, and night shift workers were 62.4 (97.6), 52.1 (87.6), and 54.2 (93.8) g of alcohol, respectively. Night shift workers showed higher percentages of high-intensity (9.3%) drinking than the other two groups (adjusted $p < 0.001$).

According to results obtained using the longitudinal fixed-effects logistic regression model (Table 2), changes in exposure to night shift work were significantly associated with corresponding changes in high-intensity drinking (OR = 1.28, 95% CI = 1.08–1.53). Night shift work was negatively associated with at-risk drinking (OR = 0.85, 95% CI = 0.74–0.98). The results remained significant after adjustments were made for average drinking amount, having young children, working hours, and job demands. The estimated ORs were similar in crude and adjusted models, probably because the covariates did not change a lot between the surveys. Nonnight shift work was not significantly associated with at-risk drinking. However, the sex interaction indicated that nonnight shift work was negatively associated with at-risk drinking in men (adjusted OR = 0.67, 95% CI = 0.51–0.88) but not in women (adjusted OR = 0.97, 95% CI = 0.86–1.10, $p = 0.63$).

Table 3 shows the association between shift intensities and drinking behaviors. A high percentage of long shifts was negatively associated with at-risk drinking

(adjusted OR = 0.58, 95% CI = 0.37–0.93). Otherwise, high-intensity drinking was not associated with shift intensities.

We further identified 1390 and 1227 participants who worked night shifts in any two waves of survey, but had different status of drinking behaviors (e.g., had vs. had no at-risk drinking) in the two waves of survey. Longitudinal fixed-effects regressions showed that difficulty falling asleep was associated with at-risk drinking (adjusted OR = 1.34, 95% CI = 1.07–1.68) and high-intensity drinking (adjusted OR = 1.44, 95% CI = 1.13–1.84) when the participants worked night shifts.

DISCUSSION

We used a large longitudinal cohort to examine the associations between shift work and drinking behaviors. We discovered that compared with regular day work, night shift work was associated with an increased risk of high-intensity drinking but a lower overall consumption of alcohol. These associations were directionally similar for nonnight shift work. Among all shift workers, employees with a high percentage of long shifts consumed less alcohol than those who rarely worked long shifts. Difficulty falling asleep was associated with high-intensity drinking and high alcohol consumption among night shift workers.

Compared with other European populations, Finnish people do not drink more

frequently, but binge drinking is reported to be more prevalent.[38,39] Binge drinking has been associated with work stress, such as job insecurity and not feeling adequately remunerated.[5] Relevant studies of high-intensity drinking targeting the working population remain scarce. We observed a 28% higher risk of high-intensity drinking (drinking until passing out in the past year) when working night rather than day shifts. This finding was consistent with that of two cross-sectional studies in Australia,[40,41] and it has been suggested that shift workers binge drink to cope with sleep problems and nightshift-related stress.[42] We suggest that high-intensity drinking is a health and safety problem while working night shifts and this drinking behavior should be prevented.

In this study, we also observed associations of difficulty falling asleep with high-intensity drinking, but shift intensities were not associated with high-intensity drinking. These observations suggested that the individual adaptation of sleep to circadian disturbances caused by shift work may play a greater role than shift work per se in the association between shift work and high-intensity drinking. A few factors were found to associate with shift work tolerance, including age, chronotype, and sleep and diet behaviors.[43] Although sleep disturbance has been associated with frequent alcohol consumption to cope with sleep problems while working shifts in cross-sectional studies,[7,8,40,44] the causal relationship cannot be confirmed because

unhealthy alcohol consumption could reciprocally lead to sleep problems. A statistical model that examines the interaction effect between shift work and sleep disturbance on drinking behaviors is required in future studies.

Our finding that nonnight shift work was not associated with at-risk drinking (i.e., high alcohol consumption) among women is consistent with that of an earlier longitudinal study.[14] The inverse association observed in men for nonnight shift work and in both sexes for night shift work was consistent with findings from studies with sex-mixed samples.[10,12] A possible explanation for the negative association among men may be that the higher demands for time for recovery and sleep after working shifts[45] prevent men from drinking large volumes of alcohol on a regular basis. Consistently, an earlier study reported that shift workers are less likely than day workers to drink daily.[41] Our findings using register data also show that long shifts are associated with at-risk drinking. After a ≥12-hour shift, a worker may be less likely to drink socially on a regular basis or workers who drink less are more likely to choose or be chosen to work longer shifts. A 1-year study revealed that compared with workers who changed from day to night shift work those who changed from night shift to day work had higher baseline alcohol consumption and higher prevalence of smoking and obesity.[13] Workers with better health and healthier behavior may tend to be (self-) selected for shift work. The selection effect and how it operates among day

workers and shift workers requires further examination.

To our knowledge, there has been very few studies exploring the association between shift intensity and alcohol drinking. We did not find significant associations between shift intensities (except for long shifts) and drinking. One possible explanation is that the association between night shift work and high-intensity drinking was attributed to some unobserved factors, for example, rotating patterns of shifts, weekend work, consecutive shifts, and social life disturbance. More studies using objective working hour data are needed to clarify the specific aspects of shift work relating with drinking behaviors.

We used passing out as an indicator of high-intensity drinking. Passing out refers to a loss of consciousness caused by high levels of blood alcohol and typically occurs at a blood alcohol concentration of >0.30 g/dL.[46] High-intensity drinking has also been defined as drinking twice the typical binge drinking threshold, blood alcohol concentration of ≥0.16 g/dL, or drinking enough to stumble.[30] In an Australian twin register study, the 1-year passing out rate in people of working age was 7.9%,[46] which is close to our observation. Some evidence has also indicated that shift work is associated with binge drinking[40,41,47] to cope with sleep disturbances as a possible risk factor. The association between difficult falling asleep and drinking was significant among night shift workers in our study. This finding is consistent with a cross-

sectional study that suggested that day workers were less likely to drink to cope with difficulty falling asleep than night shift workers.[8] Nevertheless, more studies are required to uncover the roles of different types of alcoholic beverages for shift workers, including as sleep aids and for socializing, fatigue alleviation, and tension reduction.[48]

This study has several strengths. First, the 17-year follow-up data of a large sample enabled us to examine intraindividual changes in shift schedules and drinking behavior without the results being confounded by unobserved time-invariant individual characteristics. Second, we examined different aspects of drinking behavior and revealed distinct directions of associations. Third, register-based daily data for shift intensity were used to minimize bias resulting from self-reporting. However, the limitations of the study should also be discussed. First, the information of alcohol-use disorder diagnoses was not available in our data, and employees with clinical diagnoses of alcohol-use disorders were not identified. Instead, this study described changes in drinking behavior rather than developing the alcohol-use disorder. Those without changes in drinking behavior, such as those with sustained heavy drinking between the different survey waves, were excluded from the fixed-effects analysis. Nevertheless, other unobserved time-variant variables, such as participating in alcohol abuse rehabilitation, alcohol tolerance, or other changes in other health behaviors,

may have confounded the results. Second, drinking behaviors were self-reported and subject to social desirability bias, which may lead to an underestimation of drinking volume especially among heavy drinkers. High-intensity drinking was evaluated only by self-reported experiences of passing out rather than measurement of blood alcohol concentration or number of drinks per drinking episode.[30] Therefore, we might have underestimated the prevalence of high-intensity drinking and at-risk drinking. Nevertheless, the associations between shift work and drinking behaviors were examined using fixed-effects models, which eliminated the bias from time-invariant factors including genetic vulnerability in passing out and tendency to underreport alcohol consumption. Third, the study population, workers in the Finnish public sector, has generally favorable work conditions and less adverse health behaviors than the general population and employees of some nondeveloped countries. The register-based data on working hours were only available for hospital shift workers, meaning that we selected a group of workers who had a lower risk of drinking problems than shift workers in the industrial sector. This selection bias may partially contribute to the nonsignificant findings. Our results could only be generalized to populations with a similar background. Fourth, missing-indicator method was used for missing independent variables in the regression models, specifically for the variable “having young children”. This approach has the advantage of maintaining statistical power,

but may lead to bias when the data were missing at random.[37] Although the missingness for "having young children" was not random but related to survey years (i.e., data were absent in the 2014 survey), the ORs may have been biased in adjusted models and should be interpreted cautiously.

In conclusion, we found that employees did not drink more when they worked night shifts compared with day shifts but they were more likely to engage in high-intensity drinking. In addition, difficulty falling asleep was associated with drinking problems among night shift workers. Given that high-intensity drinking has a serious impact on not only the individuals but also the organizations and society, our findings indicate the importance of implementing preventive measures to reduce alcohol-related harm among shift workers. For example, interventions aimed at increasing awareness of the potential consequences of high-intensity drinking, enabling self-monitoring of drinking behaviors, and providing prompt help to those with drinking problems would help reduce high-intensity drinking and related harm. In addition, because alcohol disturbs sleep continuity,[9] it is important to educate shift workers about the misconception that consuming alcohol helps cope with sleep difficulties. Future studies are required to better understand the mechanisms driving increased high-intensity drinking among shift workers.

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Figure 1. Participant selection flowchart.

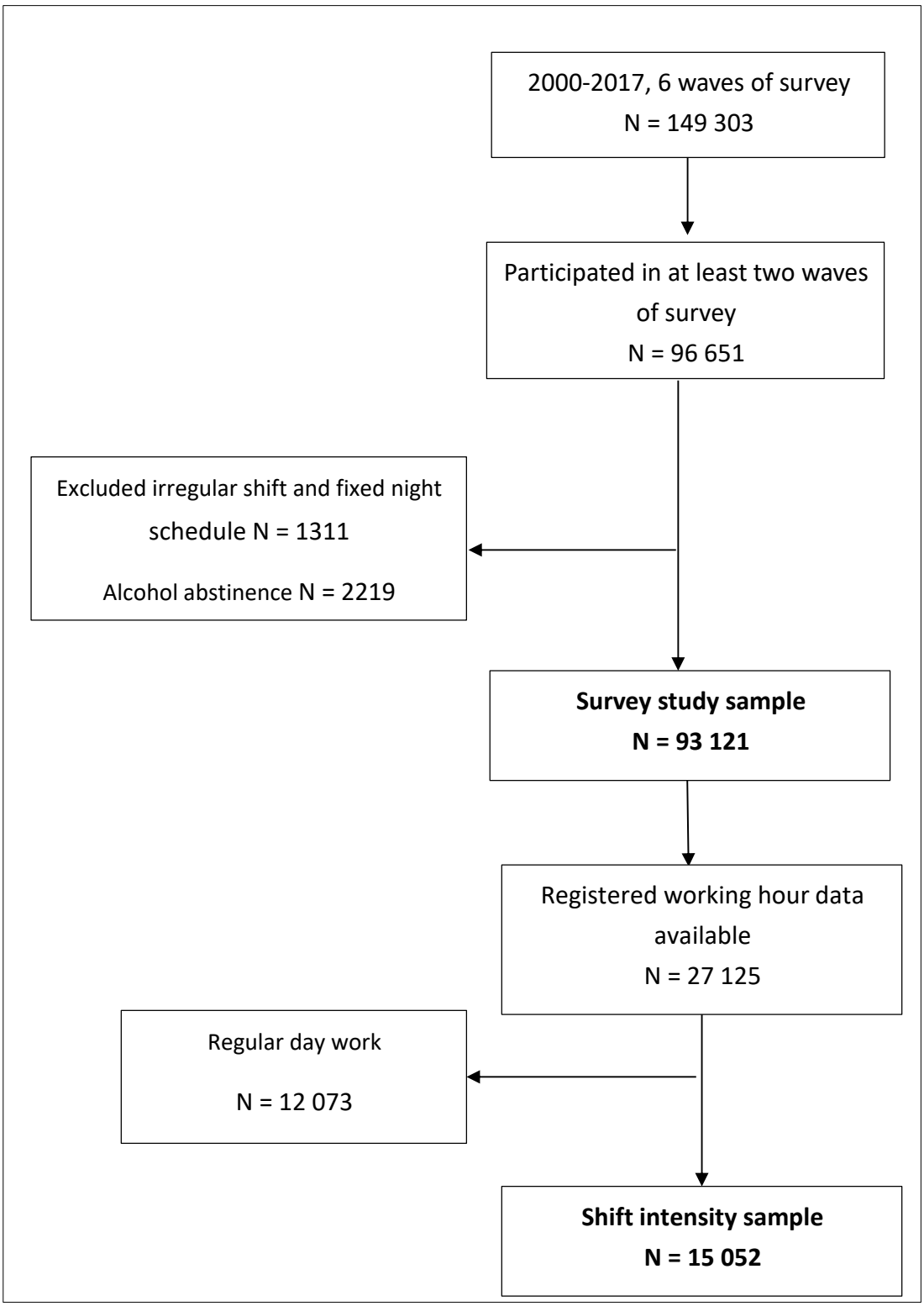

Table 1. Baseline demographics and drinking behavior of the study cohort (N = 93 121).

	Regular day workers (N=65 302)		Non-night shift workers (N=13 272)		Night shift workers (N=14 547)	
	N	%	N	%	N	%
Age						
≤39	20 572	31.50	3969	29.91	5924	40.72
40-49	20 703	31.70	3890	29.31	4353	29.92
≥50	24 027	36.79	5413	40.79	4270	29.35
Sex (Female)	52 251	80.01	11 469	86.42	11 803	81.14
At-risk drinking	8773	13.43	1519	11.45	1542	10.60
High-intensity drinking	4176	6.39	943	7.11	1346	9.25
Difficult falling asleep	7071	10.83	1994	15.02	2128	14.63
Having young children[a]	11365	17.40	2155	16.24	3206	22.04
Job demands score (mean and SD)	3.07	0.92	3.18	0.93	3.30	0.91
Working hours (hours/week, mean and SD)	39.79	7.64	39.06	7.47	38.36	6.86

[a]Data on having young children, drinking behaviors, and difficult falling asleep were missing in 44.2%, 2.3%, and 14% participants. Missing data were included in the denominators.

Table 2. Odds ratios (ORs) and 95% confidence intervals (CIs) for the association of shift work with drinking behavior obtained using the longitudinal fixed-effects model (N = 93 121, 2000–2017); the reference was day work.

	Crude model		Adjusted model[a]	Age interaction	Sex interaction
	N[c]	OR (95% CI)	OR (95% CI)	p	p
Outcome: at-risk drinking					
Non-night shift work	12 446	0.90 (0.81–1.01)	0.91 (0.81–1.02)	0.26	**0.01**
Night shift work	12 446	**0.85 (0.74–0.98)**	**0.85 (0.74–0.99)**	0.08	0.87
Outcome: high-intensity drinking					
Non-night shift work	7929	1.15 (1.00–1.33)	1.15 (1.00–1.33)	0.31	0.87
Night shift work	7929	**1.28 (1.08–1.53)**	**1.28 (1.07–1.52)**	0.12	0.81

[a]Adjusted for having young children, job demands, and working hours.

[b]Bold font indicates $p < 0.05$.

[c]N refers to the number of participants with changed drinking behavior between at least two survey waves.

Table 3. Odds ratios (ORs) and 95% confidence intervals (CIs) of the association of objective register-based shift intensities with drinking behaviors obtained using the longitudinal fixed-effects model in the shift intensities sample (N = 15 052, 2000–2017); the reference was having a percentage lower than the cutoff point for each shift intensity variable.

Outcome as at-risk drinking	cut point		Crude model	Adjusted model[a]
		N	OR (95% CI)	OR (95% CI)
> 40 hour work weeks of all work weeks	25%	1164	1.01 (0.84–1.22)	1.03 (0.84–1.25)
Quick returns of all shift intervals	25%	1188	0.90 (0.72–1.12)	0.88 (0.70–1.10)
Single days off of all day off-periods	25%	1154	0.90 (0.72–1.12)	0.92 (0.74–1.16)
Evening shifts of all shifts	25%	1181	0.93 (0.73–1.17)	0.94 (0.73–1.21)
Night shifts of all shifts	25%	1181	1.04 (0.78–1.38)	1.04 (0.78–1.38)
Long shifts of all shifts	10%	1181	**0.58 (0.37–0.92)**	**0.58 (0.37–0.93)**
Outcome as high-intensity drinking	cut point		Crude model	Adjusted model[a]
		N	OR (95% CI)	OR (95% CI)
> 40 hour work weeks of all work weeks	25%	953	0.96 (0.78–1.18)	0.91 (0.73–1.13)
Quick returns of all shift intervals	25%	969	1.02 (0.79–1.32)	1.00 (0.77–1.29)
Single days off of all day off-periods	25%	938	1.06 (0.82–1.38)	1.05 (0.81–1.36)
Evening shifts of all shifts	25%	964	0.88 (0.66–1.16)	0.86 (0.65–1.15)
Night shifts of all shifts	25%	964	1.00 (0.74–1.36)	1.04 (0.76–1.41)
Long shifts of all shifts	10%	964	1.07 (0.67–1.70)	1.08 (0.67–1.74)

[a]Adjusted for having young children, job demands, and working hours.

[b]Bold font indicates $p < 0.05$.